

Reference physics lists

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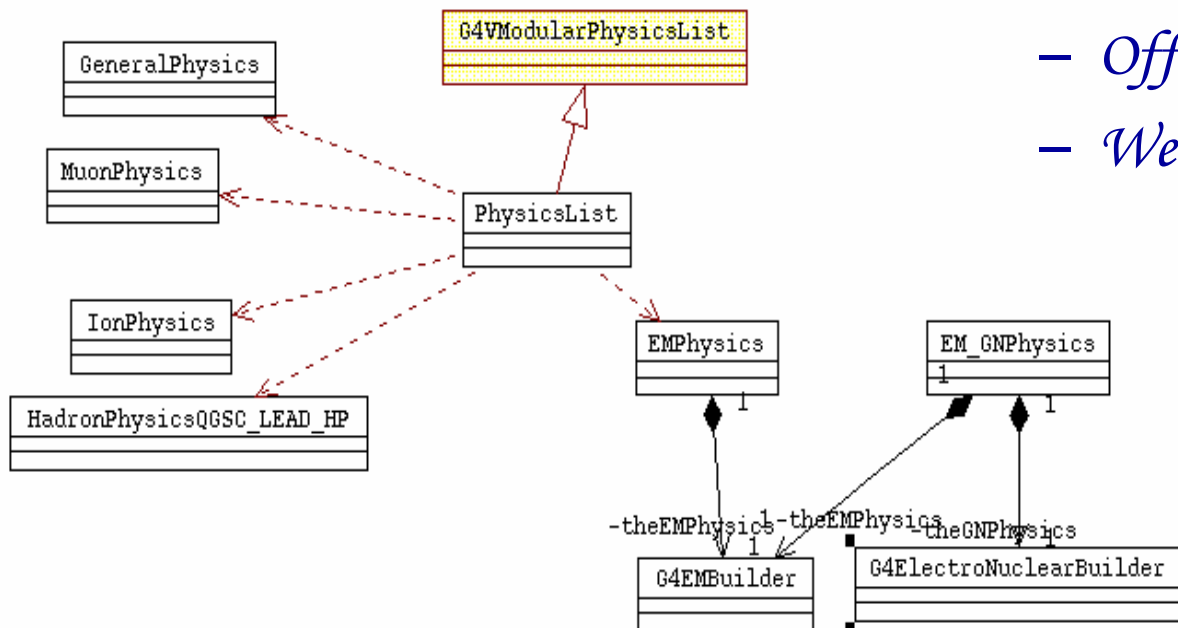
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Origin & Design

- *‘Reference physics lists’*
 - originally created by HP Wellisch as *‘Educated Guess Physics Lists’*
- *Problem domain oriented*
 - Covering 14 fields from HEP calorimetry to medical to low background experiments



- Offering 21 (+1) physics lists
- Web based guidance

Regrouping physics

Before 8.0

- *GeneralPhysics*
 - *Decay unstable particles*
- *MuonPhysics*
 - *EM physics for muons and tau*
 - *Capture at rest for mu-*
- *IonPhysics*
 - *Ionisation, Mult. Scattering, elastic for D, T, He and generic Ion*
 - *No inelastic hadronic process*
- *EMPhysics*
 - *Optionally including gamma-nuclear*
- *HadronPhysics..xyz*
 - *Hadron Inelastic*

Since 8.0

- *G4EmStandardPhysics*
 - *Standard EM physics for all*
- *G4EmExtraPhysics*
 - *Synchrotron Radiation & GN Physics*
- *G4DecayPhysics*
 - *Decays*
- *G4HadronElasticPhysics*
 - *Hadron Elastic scattering*
- *G4QStoppingPhysics*
 - *Stopping Physics from CHIPS*
 - *Not used for LHEP lists*
- *G4IonPhysics*
 - *Hadron Inelastic for d, t, α*
- *HadronPhysics..xyz*
 - *Hadron Inelastic*

Updates in 8.0

- *Revision of particles*
- *EM builder from EM standard*
 - *Removing the controversial plist.tmp file*
- *Gamma Nuclear physics added by default*
 - *Remove obsolete lists with gamma nuclear*
- *Added physics lists with 7.1 multiple scattering*
 - *QSQP_EMV and LHEP_EMV*
- *Added list for radiation studies*
 - *QGSP_BERT_HP*

Updates in 8.1

- *Added list with more performant em options QGSP_EMX*
- *Introduce Chips modeling for stopping particles in all physics lists based on QGS and FTF.*
 - *Replaces capture processes for μ^- , π^- , and K^-*
 - *Replaces annihilation at rest for anti-proton and anti-neutron*
- *Updated elastic scattering in all physics lists based on QGS and FTF using improved multiple scattering*
- *New experimental physics QBBC, minimizing use of LHEP models*

Open Problems

- *Physics lists not integrated into G4 build system*
 - *Users need to build explicitly*
 - *Users need to link to libraries explicitly*
- *Shared granular libraries do not work*
 - *All physics is referred to → dependant on all physics libraries*
- *Web documentation needs improvement*
 - *Only minimal improvements since 7.1*
- *Too much choice!*
 - *Some lists get extensive testing, others minimal*
 - *Document what we test or not*

Summary

- *LHC experiments rely on reference physics lists*
 - *Request better integration*
 - *Use only very few lists*
- *Structure has been improved with 8.0 and 8.1*
 - *Block per type of physics*
 - *Easier update/improvement of these building blocks*
- *Improved models made available*
 - *Gamma Nuclear is included by default*
 - *Better elastic scattering*
 - *Improved stopping physics*